

“The reduction in preventable rehospitalizations for heart failure remains a significant challenge, especially in terms of direct health care costs; although very promising for intermediate-risk patients, multidisciplinary case management has proven to be limited in many conditions, especially for high-risk patients. Big data-driven predictive models are currently being developed to predict readmission probability and enhance patient stratification.”

Gaps in the continuum of care of heart failure: is artificial intelligence the missing link?

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Hear failure is common and associated with high mortality, poor quality of life, and a heavy economic burden related to the high rate of unplanned readmissions. Many of these readmissions are preventable, as they are mostly due to patient-related behavioral factors. Bridging inpatient and post hospital services may help provide a comprehensive management system, leading to less fragmented care and improved interprofessional communication, ultimately allowing for better outcomes and reduced health care costs. Here, we briefly review the main strategies that could help reinforce the continuum of care for heart failure patients, focusing on three axes linked in a longitudinal perspective: in-hospital initiatives, transitional care, and outpatient initiatives. We also highlight the possible upcoming role of artificial intelligence in the present setting, offering a unique perspective for enhancing risk prediction and clinical decision making.

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Introduction

The need to improve the continuum of care for heart failure (HF) patients is no longer in doubt, as achieving less fragmented care ensures better outcomes and reduces direct health costs.¹ As up to one-half of HF patients will experience unplanned readmission within 3 to 6 months after an acute episode, rehospitalization has become a highly valuable health care quality measure and a strong target for effective cost reduction, especially since the majority of rehospitalizations are related to behavioral factors and thus are preventable.² Here, we review the fundamental strategies to reduce the fragmentation of care, arbitrarily separating three axes: in-hospital initiatives, transitional care, and outpatient initiatives, these elements being largely entangled in practice. We also briefly highlight the potential upcoming role of artificial intelligence (AI) in the improvement of the continuum of care in HF patients.

In-hospital initiatives

◆ Hospital discharge

Revisiting hospital discharge strategies is crucial in regard to patients managed for HF, as such strategies can improve the continuation of care and significantly decrease readmissions.³ As such, having a standardized discharge plan is mandatory and could begin to be implemented as soon as possible after admission with a comprehensive assessment of the patient's global needs.⁴ Recently, the Italian Working Group on Heart Failure drafted a guidance document for the organization of a

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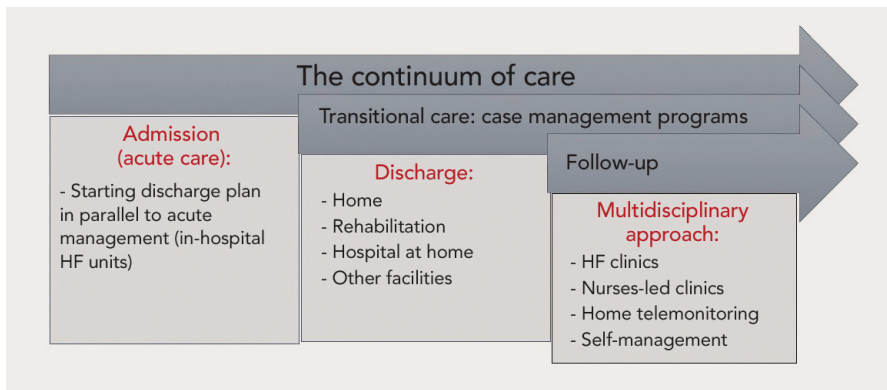


Figure 1. The continuum of care for heart failure patients: a longitudinal perspective. Most interventions begin at admission and continue for varying periods after discharge. Abbreviation: HF, heart failure.

HF care network.⁵ This document reviewed the major steps for a successful discharge; it also brought attention to the need to begin with proper patient stratification at admission through a general approach that integrates various tools dedicated to patient education, primary care provider information, and early outpatient follow-up (see below).⁵

◆ In-hospital heart failure clinics

Specific in-hospital HF clinics involving a multidisciplinary HF team (working along with general practitioners) have proven to be an efficient collaborative model within primary care facilities for the management of HF patients; they have achieved significant reduction in readmissions and mortality (30-day and 1-year rates) and improved evidence-based practice in comparison with routine management.⁶⁻⁸

Transitional care

Transitional care refers to the continuity of care a patient receives on moving from one health care facility to another (eg, from the hospital to the next health care facility⁹⁻¹¹) or on discharge to home (with or without home care services¹²). Care transition has to be seen as a longitudinal dynamic process that adapts in real time to the continuous changes of a patient's needs and global condition (Figure 1).¹³ An efficient transition helps to avoid gaps in the continuum of care and ensures sustainable communication between patients, families, and various health care providers.¹⁴ These programs yield an early and significant impact by lowering hospital readmissions for recurrent HF (one-third, according to some data) up to 180 days after discharge.¹⁴⁻¹⁷

◆ Case management programs

Case management programs also promote the continuity of care, as they unite health care providers from various backgrounds toward implementing the plan of care that began during hospitalization.^{18,19} These programs integrate a multidisciplinary approach as well, linking inpatient and post-hospital services.²⁰ Recent German experience showed that patients involved in the CorBene—Better Care for Patients With

Heart Failure case management program had better survival and lower risk of hospital readmission than patients receiving routine management.¹⁴

◆ Other specific initiatives

There is growing interest in “longitudinal” initiatives designed to improve patient outcomes through the promotion of evidence-based practice and the implementation of quality care.²¹ Among these initiatives are the GWTG-HF (Get With The Guidelines-HF),²² Hospital-to-Home campaign,²³ Optimize Heart Failure Care,²⁴ and the IMPROVE-HF²⁵ (registry to Improve the

Use of Evidence-Based Heart Failure Therapies in the Outpatient Setting) programs. Each program provides specific resources to patients/families/primary care services (eg, written information, videoconferencing and webinars, phone apps, and social media platforms) dedicated to the implementation of evidence-based management and post discharge follow-up.²²⁻²⁵ These initiatives have shown significant benefits regarding care quality and adherence to evidence-based management, costs of care, readmission rates, quality of life, and more importantly, mortality.^{3,18,21,26} Moreover, collected data will allow for a better understanding of practices in terms of HF management in hospitals participating in these initiatives.²⁶

Outpatient initiatives

◆ Outpatient heart failure clinics

HF phenotypes have widely changed over recent decades, with patients affected being more frequently older and having more comorbidities.^{2,3} This population seems to be inadequately addressed by current management, as is reflected by the unacceptable rate of readmissions (20%-40%).² As mentioned, up to one-half (42%-65% according to data) of these readmissions are related to behavioral factors and thus could be preventable.² In this setting, the GWTG-HF program reported that less than 40% of HF patients have an early follow-up after discharge from acute care, whereas guidelines recommend a follow-up within 10 days after discharge.²⁷ Facing this specific issue, dedicated HF clinics, whether built around multidisciplinary teams or specifically led by HF nurses, have been shown to be valuable for close follow-up after discharge, improving outcomes and quality of care, decreasing

SELECTED ABBREVIATIONS AND ACRONYMS

AI	artificial intelligence
GWTG-HF	Get With The Guidelines – Heart Failure [program]
HF	heart failure
IMPROVE-HF	[Registry to] Improve the Use of Evidence-Based Heart Failure Therapies in the Outpatient Setting

hospital readmissions, and enhancing patient self-management.²⁸⁻³⁰ Importantly, these programs also frequently achieve better optimization of HF medications (eg, a reduction in time needed to achieve optimal doses, a higher percentage of patients receiving optimal doses of HF medications that have been shown to lower mortality in HF) than routine management by general practitioners.^{31,32}

◆ **Telemonitoring**

Telemonitoring was shown to be a valuable transitional care tool with regard to some geographic characteristics that limit patient access to many medical and/or nonmedical facilities.³³ Telemonitoring usually involves a structured telephone-based monitoring system that collects daily patient information (weight, blood pressure, heart rate and rhythm, medication), with these data usually being reviewed by dedicated nurses.^{34,35} Some programs are also set up with specific monitoring systems that provide an alert when certain prespecified information is recorded by patients, allowing rapid medical intervention.³⁴ Telemonitoring was demonstrated to lead to a significant reduction in HF readmissions compared with routine follow-up, and to reduced mortality rates at 12 months compared with usual care.³⁶⁻³⁸

◆ **Patient self-management**

Self-management programs in HF are designed to support patient participation in management of his or her chronic condition, improving adherence to medication, diet, and regular monitoring through valuable logistical interventions.³⁹ Benefits from self-management have been shown to be particularly important among specific subgroups of patients, as geographic (eg, rural setting with poor accessibility to health services, see above) and demographic factors (eg, scarcity of medical and/or nonmedical resources) are of importance in care fragmentation.^{34,38} However, some variables may play a role in the effectiveness of such programs, as patients with underlying cognitive impairment may have a lesser long-term benefit.⁴⁰ Formal assessment of cognitive status is then mandatory when exploring potential implementation of self-management in HF patients.^{40,41} Importantly, patients with poor education and older age equally benefit from empowerment initiatives, as these programs are specifically tailored for them.^{41,42}

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Enhancing risk prediction with deep learning and big health data analytics

The reduction in preventable rehospitalizations for HF remains a significant challenge, especially in terms of direct health care costs; although very promising for intermediate-risk patients, multidisciplinary case management (detailed above) has proven to be limited in many conditions, especially for high-risk patients.^{43,44} Big data–driven predictive models are currently being developed to predict readmission probability and enhance patient stratification through machine learning algorithms and thousands of underexploited pieces of information present in hospital data and patient records.^{45,46} These technologies provide an opportunity to rethink “conventional” risk assessment by integrating risk factors through all available patient data (demographics, laboratory results, imaging, medications, genomics, etc).⁴⁵⁻⁴⁸ According to recent data, some of the recently developed models seem to perform better than conventional predictive models, particularly in regard to the accuracy of predicting 1-year readmissions, allowing preventative medical interventions.^{47,48} Although routine clinical applications are yet to be determined, big data–driven predictive models seem at this point to be very encouraging, as they potentially offer a unique opportunity for enhanced risk stratification and personalized care, keeping in mind the inherent risks regarding privacy, security, and data ownership.^{45,46}

Conclusion

Data regarding the high rate of readmissions leave no doubt that the current management of HF patients is far from being optimal. Integrating inpatient and post hospital health services over a longitudinal flow that starts early in the care cycle and evolves with the patient's condition has proven benefits in terms of prognosis and quality of life. However, transitional care needs to be adapted to the reality in the clinic, since many geographic, demographic, and cultural characteristics do not allow generalization. Key elements for the optimization of the continuum of care include efficient discharge planning, optimal transitional care program, close follow-up, and patient empowerment and self-management. AI offers a unique emerging opportunity to rethink risk assessment and might help reshape the HF patient's journey when combined with more traditional concepts of transitional care. ■

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